2-E-65

INSTRUCTION MANUAL

MODELS 95D AND 95F
VARIABLE LOW-PASS
OUTPUT FILTER

emr
ASCOP
Electro-Mechanical Research, inc.
EXECUTIVE OFFICES
SARASOTA FLORIDA
ASCOP DIVISION
PRINCETON NEW JERSEY

INSTRUCTION MANUAL

MODELS 95D AND 95F
VARIABLE LOW-PASS
OUTPUT FILTER

Applies to serial number 306 and higher.

Electro-Mechanical Research, Inc.

Sarasota, Florida

July, 1961

EMR MODEL 95 VARIABLE LOW-PASS OUTPUT FILTER

TABLE OF CONTENTS

SECTION			PAGE NO.
I	DESCRIPTION		
	1.1	General	I-1
	1.2	Characteristics	I-1
II	INSTALLATION AND OPERATION		
	2.1	Installation	II-1
	2.2	Cooling	II-1
	2.3	Electrical Connections	II-2
	2.4	Front-Panel Controls, Meter, and Jacks	II-2
	2.5	External Control of Gain	II-4
	2.6	External Zero Offset	II-4
III	THEORY OF OPERATION		
	3.1	General	III-1
	3.2	Circuit Description	III-1
IV	TROUBLE-SHOOTING AND MAINTENANCE		
	4.1	Inspection	IV-1
	4.2	Voltage Measurements	IV-1
	4.3	Performance Tests	IV-1
	4.4	Maintenance	IV-1
V	TABLES AND DRAWINGS		
	Figure V-1:	Rolloff Characteristics	
	Figure V-2:	Schematic, Model 95D	
	Figure V-3:	Schematic, Model 95F	
	Figure V-4:	Tube-Socket Voltages	
	Figure V-5:	Component Location, Top View	
	Figure V-6:	Component Location, Bottom View	
VI	REPLACEABLE SPARE PARTS		

SECTION I
DESCRIPTION

1.1 GENERAL

The EMR Model 95 Variable Low-Pass Output Filter combines a power amplifier flat to dc with a low-pass electronic filter network having continuously variable cutoff frequency. Although specifically designed for use with the EMR Model 97 Tunable Discriminator in FM telemetry applications, it finds use wherever a flexible filter is required, particularly when high output capability is needed.

The Model 95 provides a cutoff frequency that can be adjusted for any point between 3 cps and 10.5 kc. Attenuation beyond cutoff is at the rate of 36 db per octave. Two attenuation characteristics are provided in the pass band. The first is flat within ±0.5 db from dc to the cutoff frequency. The second provides a gradual or Gaussian rolloff which is down 3 db at the cutoff frequency and which has a linear phase characteristic.

A power amplifier at the output of the filter delivers up to ±90 volts peak at a maximum current capability of ±25 ma peak. The maximum gain through the unit is 15. A continuous reduction of gain to 0.8 is possible.

A center-zero meter on the front panel provides a continuous indication of the dc level at the input. Full scale is ±6 volts.

Two versions of the Model 95 are available. The Model 95D contains an electronically regulated low-voltage supply but the line-voltage input must be frequency regulated; the Model 95F operates from an unregulated-frequency source but requires 15 watts from a voltage-regulated source for application to certain heaters.

1.2 CHARACTERISTICS

1.2.1 ELECTRICAL

Frequency Range: Pass band is from dc to any cutoff frequency between 3 cps and 10.5 kc.

Attenuation: In the pass band, flat response (±0.5 db) or Gaussian rolloff (3 db down at cutoff frequency); above cutoff, asymptotic to a slope of 36 db per octave.

Input Impedance: 40,000 ohms minimum. Input is applied directly to an electronic filter network. (Maximum source impedance is 1000 ohms.)

Maximum Output Level: ±90 volts peak at ±25 ma peak, single-ended and referred to ground. Level is continuously adjustable over a range greater than 15:1.

Output Impedance: Less than 10 ohms.

Output Noise: In the wide-band, full-gain position, less than 60 millivolts rms or 0.1% of full-scale output. Output noise is proportional to gain.

Harmonic Distortion: Less than 1% within rated operation.

Linearity: ±0.1% of full bandwidth, based on the best straight line.

Output Stability: In full-gain position, drift is less than 0.5 volt in a 15-hour period after a 15-minute warm-up. Output voltage variation due to a variation in power-source voltage is less than 25 millivolts for a change from 105 to 125 volts.

Automatic Calibration: Provision is made for the introduction of an external zero-offset voltage and for external control of the gain.

Power Requirements:

Model 95D--190 watts at 105 to 125 volts unregulated, 60 cps.
Model 95F--175 watts at 105 to 125 volts unregulated, 55 to 70 cps; 15 watts at 115 volts ±1%, 55 to 70 cps.

1.2.2 MECHANICAL

Panel Size: 5-1/4 in. by 19 in.

Chassis Size: 16-3/8 in. wide by 16-1/8 in. deep.

Over-all Depth: 16-3/8 in. maximum.

Weight: 47 pounds.

Controls (all on front panel):

"Output Volts at Band Edge" switch (fine adjustment within selected range made possible by potentiometer-control knob on switch shaft)
"Increase Sensitivity" pushbutton
"Amplifier Zero Balance" switch and potentiometer control (screwdriver-type)
"Freq. Range" switch
"Cutoff Frequency" potentiometer (fine tuning)

"Freq. Characteristic" switch
"On-Off" switch

Indicator: Pilot bulb light when power is on.

Meter: "Output"

Test Points: "Input" and "Output" pin jacks (front panel).

Connector: Cannon type DPD-D32C2-34P-1L. Mates with Cannon type DPD-D32C2-33S-1L (supplied).

SECTION II
INSTALLATION AND OPERATION

2.1 INSTALLATION

When slides are not used, the Model 95 can be mounted in the rack by means of angle brackets that support the unit on its side brackets.

When pullout, nonturnover slides and slide-mount hardware have been specified, a spacer bar having three screw holes is supplied on each side of the Model 95. After the slides have been installed in the rack, pull forward the innermost subassembly of the slides until the full-extention stop engages. Depress the stop button and completely withdraw this subassembly. Mount the subassembly to the spacer bar on the Model 95 by means of the three No. 10-32 screws provided. Repeat this procedure for the other side of the Model 95, then insert the unit into the rack--again depressing the stop button.

When pullout, turnover slides and slide-mount hardware have been specified, a spacer bar having six screw holes and a helical insert is supplied on each side of the Model 95. After the slides have been installed in the rack, pull forward the innermost subassembly of the slides until the full-extension stop engages. Depress the stop button and completely withdraw this subassembly. Mount the subassembly to the spacer bar on the Model 95 by means of the six Phillips screws provided. Use the indexing pin to locate the tilt mechanism in the 0° (horizontal) position. Repeat this procedure for the other side of the Model 95, then insert the unit into the rack--again depressing the stop buttons. The tilt mechanism provides seven positions: 0°, $\pm 45^{\circ}$, $\pm 90^{\circ}$, and $\pm 105^{\circ}$.

Secure the unit in the rack by means of the two twistlock fasteners located beside the handles.

2.2 COOLING

The physical construction of the Model 95 Variable Low-Pass Output Filter is similar to that of most other EMR rack-mounting equipment. All power-consuming components are extended into a chimney area to allow for forced-air cooling from a blower mounted at the bottom of the rack. This design extends the useful life of components and contributes toward maximum dependability with a minimum of maintenance. Because of this EMR construction practice, almost any EMR rack-mounting equipment can be placed above or below the Model 95 without obstructing the chimney formed when a number of units are stacked in a rack.

2.3 ELECTRICAL CONNECTIONS

The appropriate schematic diagram in Section V shows proper power connections to Models 95D and 95F.

The Model 95D operates from a 190-watt source of 105 to 125 volts unregulated, 60 cps. The Model 95F operates from a 175-watt source of 105 to 125 volts unregulated, 55 to 70 cps, and a 15-watt source of 115 volts ±1%, 55 to 70 cps.

Connect pins 1 and 2 (on Model 95D) or pins 1-4 (on Model 95F) to the proper power source(s), then turn the power switch on.

2.4 FRONT-PANEL CONTROLS, METER, AND JACKS

Functions and operation of the various controls located on the front panel of the Model 95 are described below. NOTE: Be sure to perform the procedure described in par. 2.4.6 during initial setup of the Model 95.

2.4.1 CUTOFF FREQ. DIAL AND FREQ. RANGE SWITCH

The desired cutoff frequency is obtained with the Freq. Range switch and the associated Cutoff Freq. dial. Each detent position of the switch indicates the appropriate scale of the dial and the multiplier of the basic dial frequency.

2.4.2 FREQ. CHARACTERISTIC SWITCH

This switch provides either a "standard" (flat) or a Gaussian rolloff characteristic beyond cutoff. These characteristics are shown in Figure V-1 and are described in par. 1 2.1, above.

2.4.3 OUTPUT VOLTS AT BAND EDGE CONTROL

This concentric dual control provides continuous adjustment of output level by means of an outer, vernier-potentiometer knob and an inner, switch knob. The switch provides nominal ranges of 5-10, 10-20, 20-40, and 40-90 peak output volts for an input of ±6 volts peak. Actual ranges overlap slightly. The vernier potentiometer provides fine adjustment within each range.

When the switch is in the Ext position, gain can be controlled externally. Refer to par. 2.5.

2.4.4 OUTPUT METER

The Output meter measures the dc signal level out of the Model 95. Its location, in the feedback circuit of the output amplifier, is such that the meter reading is independent of the setting of the Output Volts at Band Edge control. The meter reads ±100 for ±6 volts dc at the input of the Model 95.

2.4.5 INCREASE SENSITIVITY PUSHBUTTON

The Increase Sensitivity button increases meter sensitivity approximately eight times. It is used in conjunction with the Amplifier Zero Balance adjustment to achieve zero balance of the output amplifier.

2.4.6 AMPLIFIER ZERO BALANCE ADJUSTMENT

Zero balancing of the output amplifier should be achieved as the first step in operation of the Model 95.

Push the slotted Amplifier Zero Balance shaft inward with a screwdriver. This engages the balancing potentiometer and grounds the output amplifier. Thus only the balance of the output stage is adjusted, a necessary arrangement if the zero point of the filter is to remain independent of the Output Volts at Band Edge control.

Using either the Output meter (in conjunction with the Increase Sensitivity pushbutton) or an external meter to provide indication of balance, turn the Amplifier Zero Balance shaft until zero output is read.

The first amplifier section of the Model 95 is designed to balance at approximately zero balance of the output amplifier. This suffices for many applications. If more accurate balancing of the first amplifier is required, refer to par. 2.6 for the proper procedure.

2.4.7 INPUT AND OUTPUT TEST JACKS

The Input test jack is in parallel with pin A1 of the rear connector; the Output test jack is in parallel with pin B. Use any convenient point on the chassis for ground when monitoring the input or output with an oscilloscope or meter at these test jacks.

2.5 EXTERNAL CONTROL OF GAIN

When the Output Volts at Band Edge switch is in the Ext position, a voltage divider external to the Model 95 can be substituted for the corresponding internal divider. Connect the external divider between pin 8 of the rear connector and chassis ground, and connect the tap of the divider to pin 10.

Notes:

a) Low-capacity shielded leads must be used; total capacity to ground must be less than 700 μμf.

b) Values used in the external divider must approximate those shown at the Output Volts at Band Edge switch on the schematic diagram (in Section V). The capacitance across the upper resistor of the external divider must be included.

2.6 EXTERNAL ZERO OFFSET

Accurate zero balance of the first amplifier section can be achieved by permanently applying between approximately +30 and −30 volts at pin 19 of the rear connector and adjusting the Amplifier Zero Balance potentiometer until absolute balance is observed on the Output meter or an external meter. When the Model 95 is used in conjunction with an EMR Model 97 Tunable Discriminator, this adjustment is effected with the Zero Sig. Balance potentiometer on the discriminator.

SECTION III
THEORY OF OPERATION

3.1 GENERAL

The EMR Model 95 Variable Low-Pass Output Filter is a dc power amplifier with a feedback network. It provides a low-pass filter having a continuously variable cutoff frequency between 3 cps and 10.5 kc.

The unit is specifically designed for use in telemetry applications with the EMR Model 97 Tunable Discriminator and is essential for the operation of the Model 97. However, it can be used wherever a laboratory-type flexible filter or amplifier with high output capacity, stability, and dc response is required.

The Model 95 consists of two electronic filter amplifiers and a power supply. Each filter amplifier is composed of a high-gain dc amplifier with variable RC feedback networks. The amplifiers operate similarly, but the second amplifier has a power-output stage and a gain control.

Refer to Section V for schematic drawings of Models 95D and 95F, which differ only in the type of power supply used (see par. 1.1).

3.2 CIRCUIT DESCRIPTION

The input signal is applied to the first filter amplifier. In the pass band the over-all gain of this circuit is unity. Except when the output amplifier is being balanced, the output of the first filter amplifier is applied to the second filter amplifier, which is similar to the first circuit except that it provides an adjustable, high power gain.

The RC networks of the filter amplifiers consist of four identical ganged variable resistors which vary from 40,000 ohms to 140,000 ohms as the Cutoff Freq. dial is adjusted. Three precision capacitors are associated with these resistors for each of the seven frequency ranges when the Standard-Gaussian switch is in the Standard position; additional capacitors are in the circuit when the switch is set to Gaussian. Attenuation beyond cutoff asymptotically approaches 36 db per octave regardless of the selected output characteristic. Each of the two amplifiers contributes 18 db to this rolloff.

Two low-impedance outputs and one high-impedance output are provided. The low-impedance output signal can be applied to an oscilloscope through the front-panel Output jack.

The output circuit requires balancing prior to use. For this reason an Amplifier Zero Balance control is provided on the front panel. This control grounds the input to the second filter amplifier circuit and permits adjustment of a bias level that will provide a zero reading on the Output meter. The Output meter reading is independent of the setting of the gain (Output Volts at Band Edge) control. When the Increase Sensitivity pushbutton is depressed, the sensitivity of the meter is increased by a factor of approximately 8; this is especially useful during the balancing procedure.

SECTION IV
TROUBLE-SHOOTING AND MAINTENANCE

4.1 INSPECTION

The Model 95 should be subjected to a regular inspection program similar to that recommended for other electronic equipment A visual inspection should be made each week, checking for loose components and evidence of overheating. A complete inspection every six months should include the following:

a. Test all vacuum tubes.

b. Inspect wiring for loose connections and signs of overheating.

c. Check all tube-socket voltages.

d. Check performance.

e. Replace defective components.

4.2 VOLTAGE MEASUREMENTS

Use ground as reference for all dc and ac voltage measurements. Tube-socket voltages are listed in Section V.

4.3 PERFORMANCE TESTS

The performance of the Model 95 can be determined by means of standard procedures for dc feedback amplifiers, electronic filter networks, and regulated power supplies. The inspection record may be used in conjunction with these tests.

4.4 MAINTENANCE

Component locations are shown in Drawings B-02162 and B-02163 in Section V.

SECTION V
TABLES AND DRAWINGS

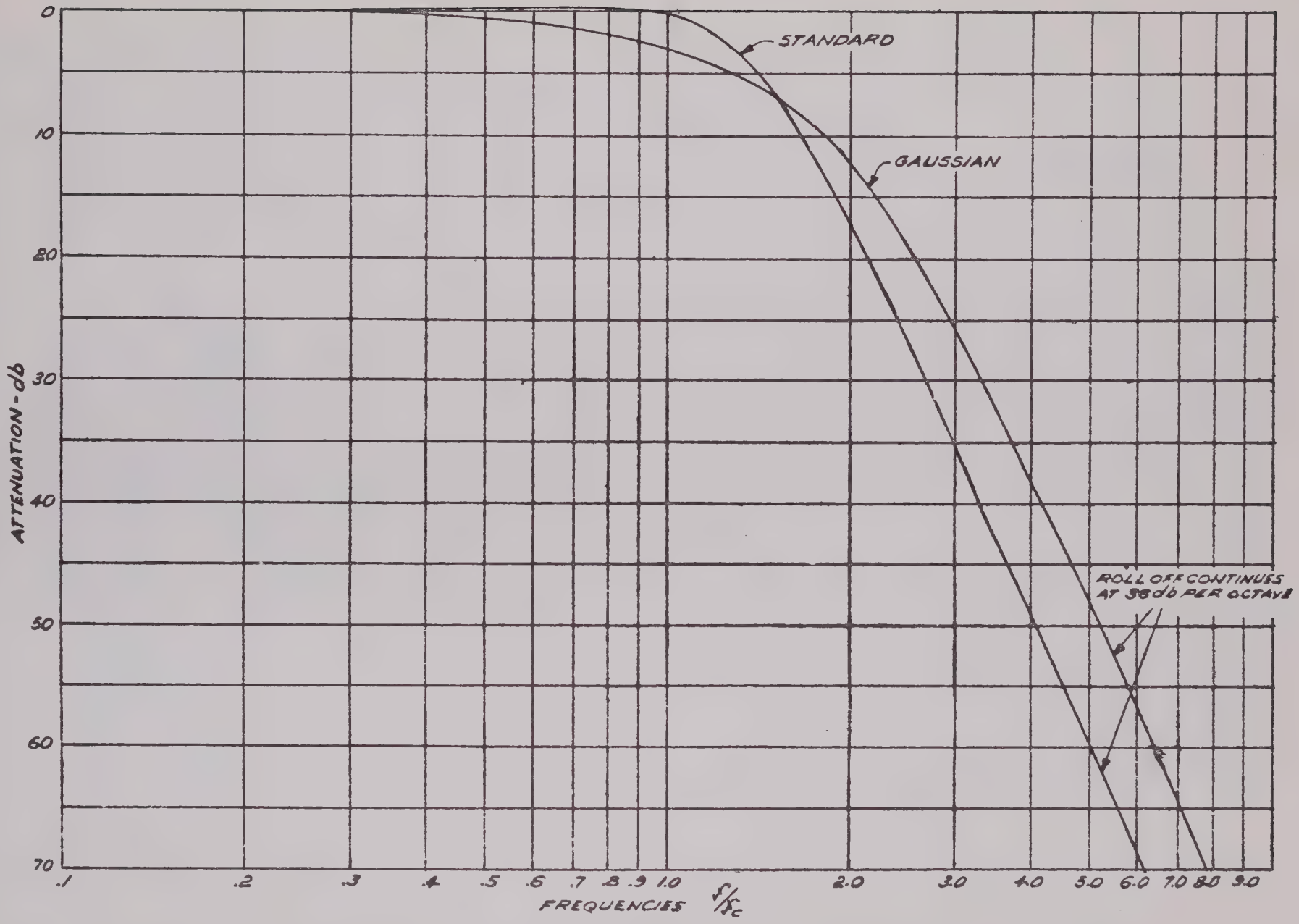


FIGURE V-1 ROLLOFF CHARACTERISTICS

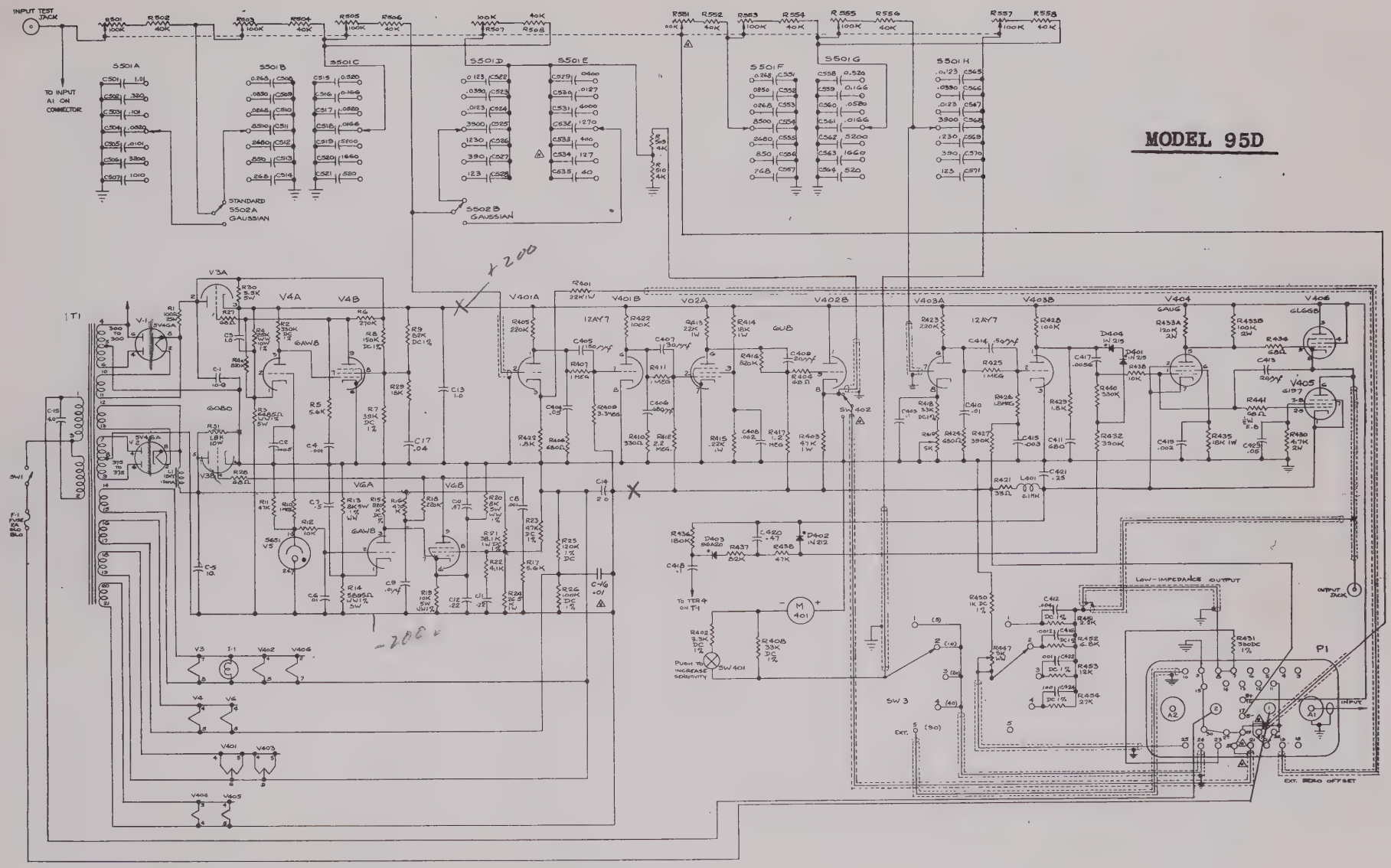

MODEL 95D
INPUT TEST JACK
TO INPUT A1 ON CONNECTOR
STANDARD 5502A GAUSSIAN
5502B GAUSSIAN
SW 3
EXT.
EXT. ZERO OFFSET
LOW-IMPEDANCE OUTPUT
OUTPUT JACK
INPUT
PUSH TO INCREASE SENSITIVITY
SW 401
SW 402
P1

FIGURE V-2

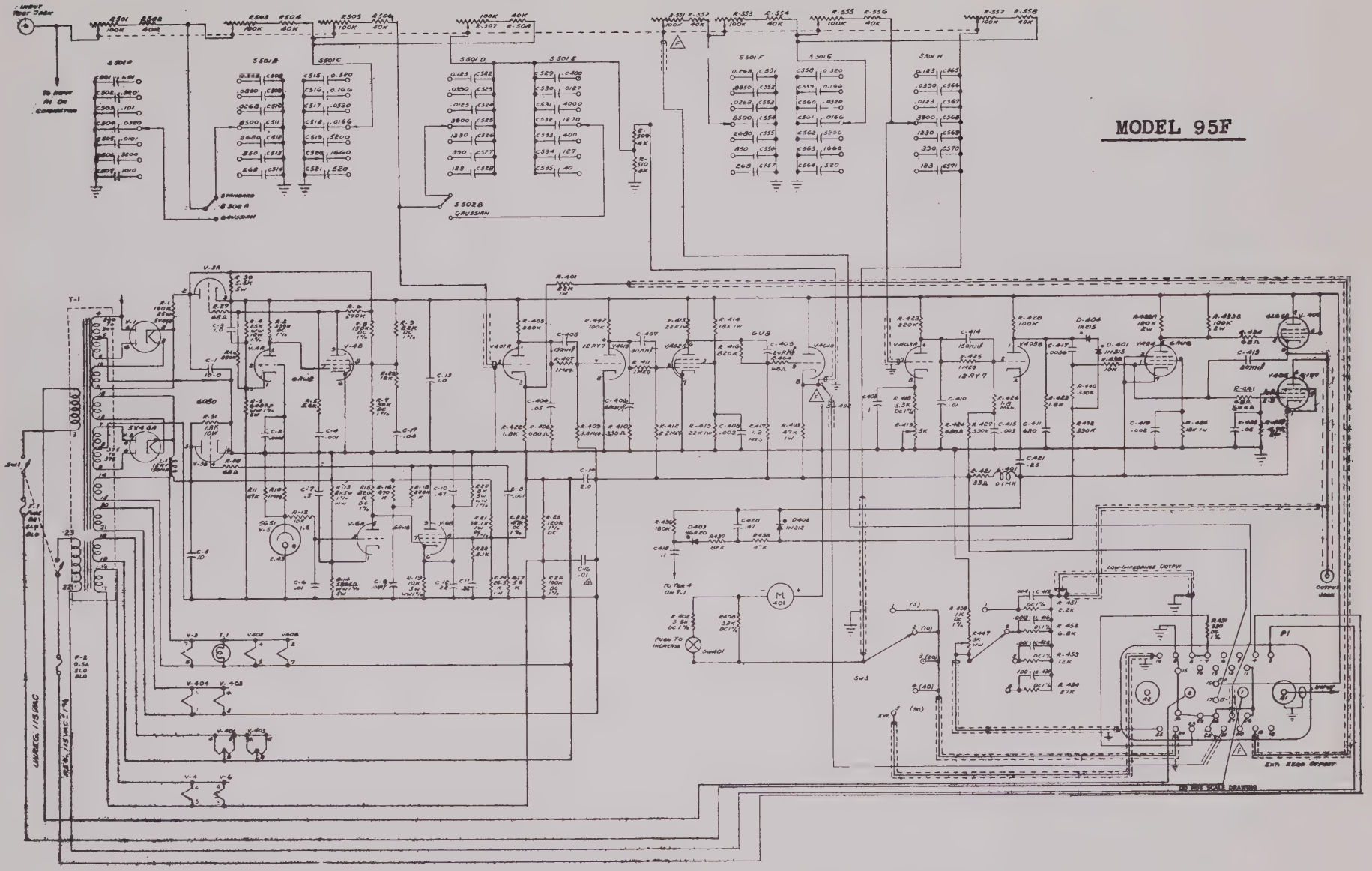


FIGURE V-3

TUBE-SOCKET VOLTAGES

MODEL 95

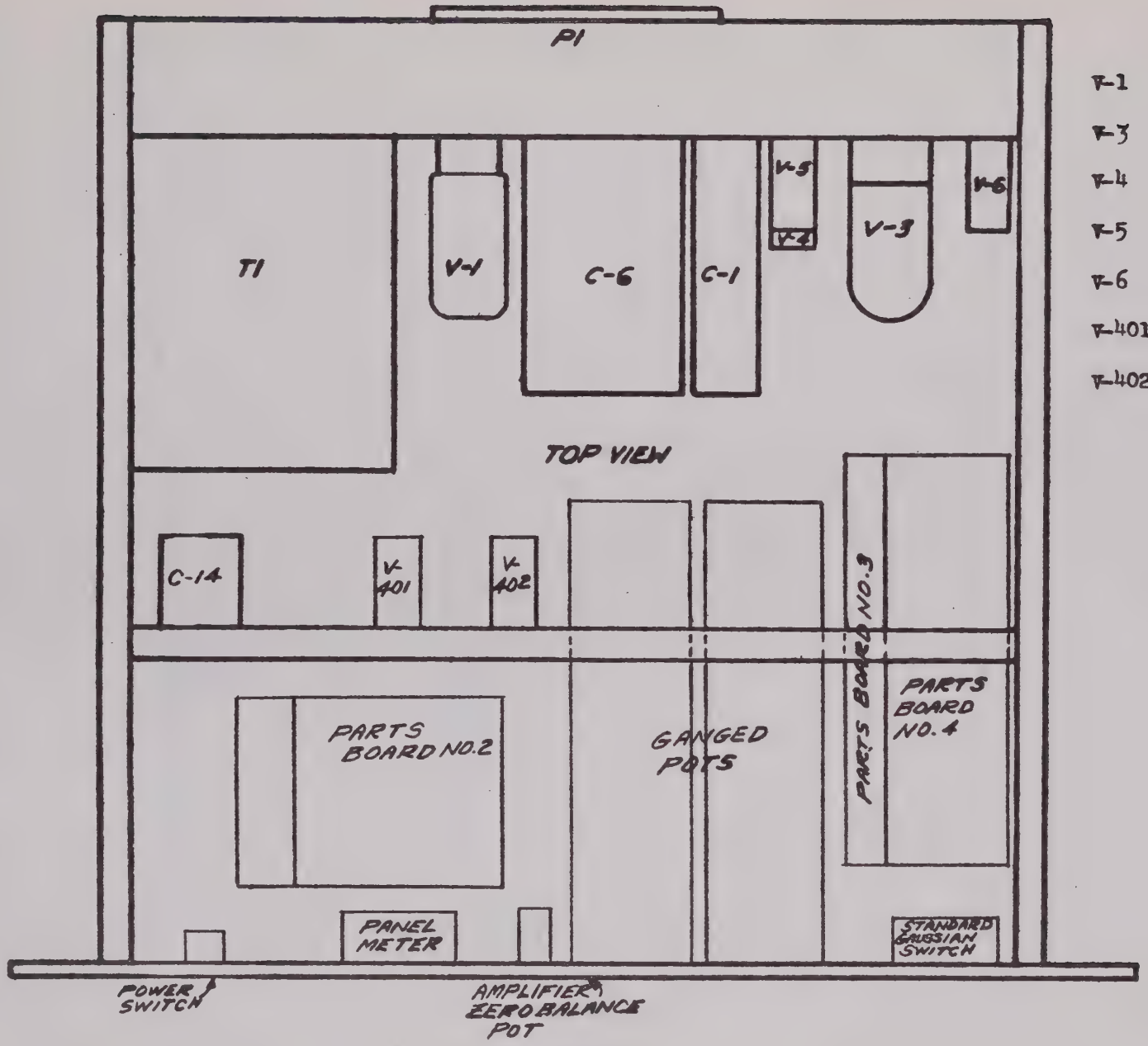
TYPICAL DC VOLTAGES Pin Numbers

Tube	1	2	3	4	5	6	7	8	9
V1	0	+350	0		0		0	+350	
V2	0	+117	0		0		0	+115	
V3	+150	+350	+200	-22	+90	0			
V4	-110	-111	-4			0	-4	+110	+142
V5	-111	-200		-200	-111		-200		
V6	-110	-111	-88			-85	-88	-60	-22
V401	+62	- .4	+1			+98	-1.6	0	
V402	+198	-2.4	+90			+115	0	- .04	-4.3
V403	+148	-3.3	0			+98	- .03	+2.	
V404	-200	-195			-12	-26	-195		
V405	-195	-195	0			- .18	-195	0	-195
V406			+198	+198	-12			- .18	

AC Volts

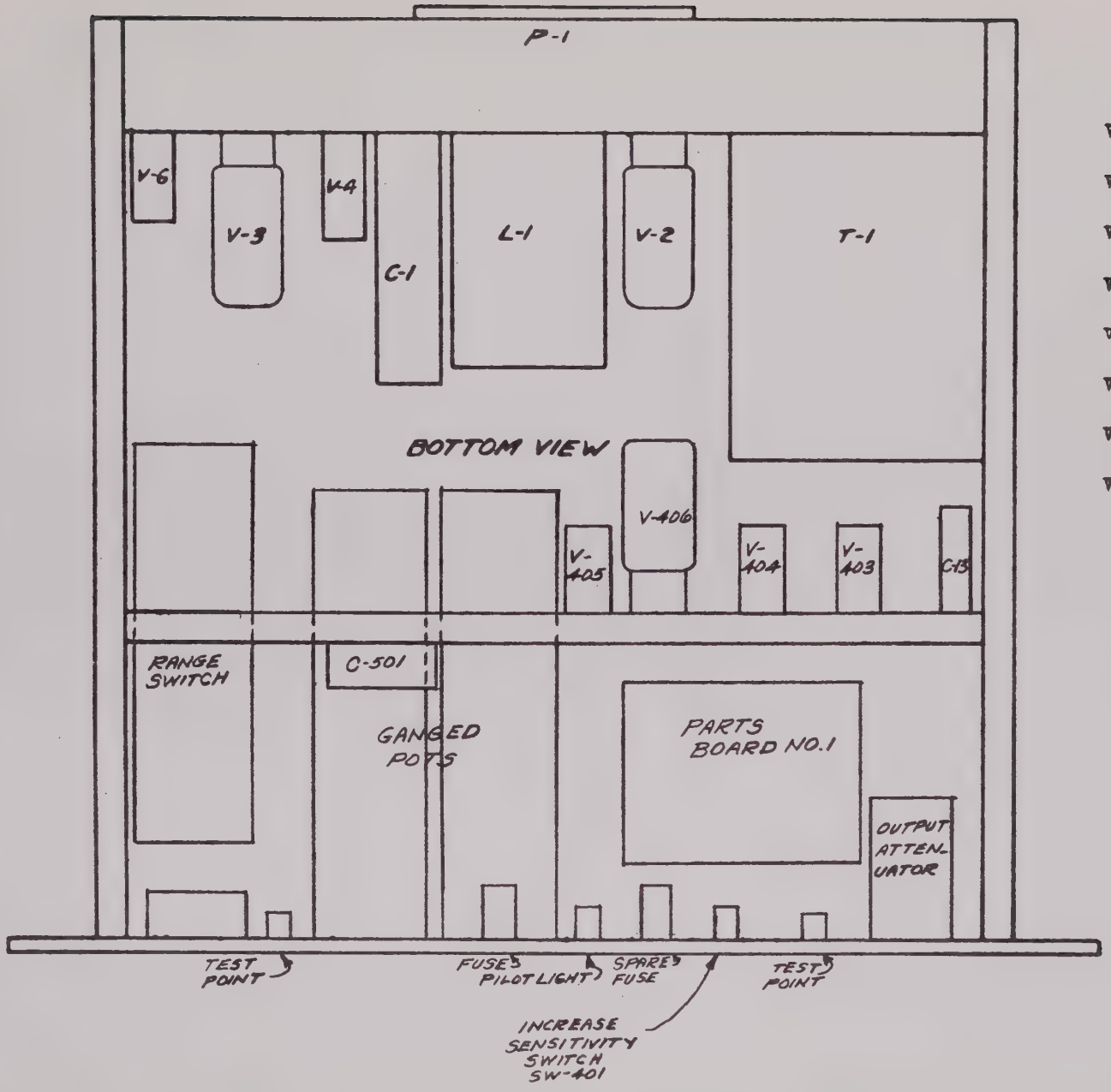
V-1		310		310	
V-2		375		375	

FIGURE V-4



V-1 - 5V4GA
V-3 - 6080
V-4 - 6AW8
V-5 - 5651
V-6 - 6AW8
V-401 - 12AY7
V-402 - 6U8

FIGURE V-5



V-2	-	5V4GA
V-3	-	6080
V-4	-	6AW8
V-6	-	6AW8
V-403	-	12AY7
V-404	-	6AU6
V-405	-	6197
V-406	-	6L6GB

FIGURE V-6

SECTION VI
REPLACEABLE SPARE PARTS

TERMINOLOGY; WARRANTY; ORDERING INFORMATION

All electrical and all critical mechanical parts used in this equipment are itemized on the following pages. Prices will be quoted upon request.

Those items designated "PP" (parts peculiar) are manufactured by or specially for Electro-Mechanical Research, Inc. Those items designated "LL" (long lead) are items which require over sixty (60) days but not more than one hundred eighty (180) days to obtain. Those items designated "QC" (Quality Control) are items which are purchased by EMR and tested to EMR specifications necessary to ensure proper operation of this equipment. Field spares are those items recommended for support of the equipment in locations where complete stock facilities are not practical.

In order to ensure availability of those parts marked "PP," "LL," or "QC," earliest possible ordering is recommended. All orders should indicate the EMR part number.

All materials employed in EMR equipment are of the best quality; however, the reliability of component parts can not be predicted or guaranteed for an indefinite period. This equipment, with the exception of batteries, tubes, and fuses, is fully guaranteed for a period of thirty (30) days following the date of shipment.

Should any questions arise concerning this parts list, please do not hesitate to call upon Electro-Mechanical Research, Inc., in Sarasota, Florida, or any EMR field office.

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX Sarasota 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER		EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO.		PP-PART PECULIAR LL-LONG LD		REMARKS
				NAME	PART NO.			BASE SPARES	FIELD SPARES			
	C1		Capacitor, fixed, paper, 10 µf ±10%, 600V	Sprague	CP70B1F-F106K	S95-001	1					
	C2		Capacitor, fixed, mica, 500 µµf ±5%, 300V	Elmenco	CM-15A	S95-002	1					
	C3		Capacitor, fixed, paper, 1 µf ±20%, 400V	Pyramid	7PGIHL	S95-003	1					
	C4 C8 C422		Capacitor, fixed, mica, 0.001 µf, ±10%, 500V	Elmenco	CM-19A	S95-004	3	0	1			
	C5		Capacitor, fixed, electrolytic, 10 µf ±10%, 400V	Cornell-Dubilier	T-4100-1	S95-005	1					
	C6 C9 C16		Capacitor, fixed, mica, 0.01 µf ±10%, 500V	Elmenco	CM-35B	S95-006	3	0	1			
	C7		Capacitor, fixed, paper, 0.5 µf ±20%, 400V	Sprague	CP54B1E-E504M	S95-170	1					
	C10		Capacitor, fixed, paper, 0.47 µf ±20%, 300V	Pyramid	301-D1 per EMR Dwg. A-00068	S95-007	1			PP-LL		
	C11		Capacitor, fixed, paper, 0.22 µf ±20%, 300V	Pyramid	PGHV	S95-008	1					
	C12		Capacitor, fixed, paper, 0.22 µf ±20%, 200V	Pyramid	PGIHV	S95-009	1					
	C13		Capacitor, fixed, paper, 1 µf ±20%, 400V	Tobe	OMB	S95-010	1					
	C14		Same as C13 except 2 µf	Tobe	OMB	S95-011	1					
	C15		Part of T1, which see.									Used only on 95D.
	C17		Capacitor, fixed, paper, 0.039 µf ±20%, 200V	Pyramid	PGHV	S95-012	1					
	C403		Capacitor, fixed, paper, 0.1 µf ±20%, 300V	Pyramid	7EPGIH	S95-013	1					
	C404 C423		Capacitor, fixed, paper, 0.05 µf ±20%, 300V	Pyramid	EPGIHV	S95-014	2					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX Sarasota 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	C405 C414		Capacitor, fixed, mica, 150 μμf ±5%, 500V	Elmenco	CM-15E	S95-015	2					
	C406 C411		Capacitor, fixed, mica, 680 μμf ±10%, 500V	Elmenco	CM-19B	S95-016	2					
	C407		Same as C405 except 30 μμf	Elmenco	CM-15E	S95-017	1					
	C408 C419		Capacitor, fixed, mica, 0.002 μf ±10%, 500V	Elmenco	CM-20B	S95-018	2					
	C409 C413		Capacitor, fixed, mica, 20 μμf ±5%, 500V	Elmenco	CM-15C	S95-019	2					
	C410		Capacitor, fixed, paper, 0.01 μf ±20%, 600V	Pyramid	EPGIXV	S95-020	1					
	C412		Capacitor, fixed, mica, 0.004 μf ±10%, 500V	Elmenco	CM-30A	S95-021	1					
	C415		Capacitor, fixed, mica, 0.003 μf ±10%, 500V	Elmenco	CM-30B	S95-022	1					
	C416		Capacitor, fixed, mica, 1200 μμf ±10%, 500V	Elmenco	CM-20A	S95-023	1					
	C417		Same as C412 except 5600 μμf	Elmenco	CM-30A	S95-024	1					
	C418		Capacitor, fixed, paper, 0.1 μf ±20%, 600V	Pyramid	7PGIM	S95-025	1					
	C420		Capacitor, fixed, paper, 0.47 μf ±20%, 200V	Pyramid	7PGIH	S95-026	1					
	C421		Capacitor, fixed, paper, 0.25 μf ±20%, 300V	Pyramid	7EPGHA	S95-027	1					
	C424		Same as C406 except 100 μμf	Elmenco	CM-19B	S95-028	1					
	C501		Capacitor, fixed, Mylar, 1.01 μf ±1%, 400V	Efcon	MHA	S95-029	1					
	C502		Same as C501 except 0.32 μf	Efcon	MHA	S95-030	1					
	C503		Same as C501 except 0.101 μf	Efcon	MHA	S95-031	1					
	C504		Same as C501 except 0.032 μf	Efcon	MHA	S95-032	1					
	C505		Same as C501 except 0.0101 μf	Efcon	MHA	S95-033	1					

Electro-Mechanical Research, inc.
P. O. BOX 3041
Phone 958-7731
SARASOTA, FLORIDA
TWX SARASOTA 6006

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	C506		Capacitor, fixed, mica, 3200 μμf ±1%, 500V	Elmenco	CM-30A	S95-034	1					
	C507		Capacitor, fixed, mica, 1010 μμf ±1%, 500V	Elmenco	CM-19A	S95-035	1					
	C508 C551		Same as C501 except 0.268 μf	Efcon	MHA	S95-036	2					
	C509 C552		Same as C501 except 0.085 μf	Efcon	MHA	S95-037	2					
	C510 C553		Same as C501 except 0.0268 μf	Efcon	MHA	S95-038	2					
	C511 C554		Capacitor, fixed, mica, 8500 μμf ±1%, 300V	Elmenco	CM-35A	S95-039	2					
	C512 C555		Same as C506 except 2680 μμf	Elmenco	CM-30A	S95-040	2					
	C513 C556		Same as C507 except 850 μμf	Elmenco	CM-19A	S95-041	2					
	C514 C557		Capacitor, fixed, mica, 268 μμf ±1%, 500V	Elmenco	CM-15A	S95-042	2					
	C515 C558		Same as C501 except 0.52 μf	Efcon	MHA	S95-043	2					
	C516 C559		Same as C501 except 0.166 μf	Efcon	MHA	S95-044	2					
	C517 C560		Same as C501 except 0.052 μf	Efcon	MHA	S95-045	2					
	C518 C561		Same as C501 except 0.0166 μf	Efcon	MHA	S95-046	2					
	C519 C562		Same as C506 except 5200 μμf	Elmenco	CM-30A	S95-047	2					
	C520 C563		Capacitor, fixed, mica, 1660 μμf ±1%, 500V	Elmenco	CM-20A	S95-048	2					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER		EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO.		PP-PART PECULIAR LL-LONG LD.		REMARKS
				NAME	PART NO.			BASE SPARES	FIELD SPARES			
	C521 C564		Same as C507 except 520 μμf	Elmenco	CM-19A	S95-049	2					
	C522 C565		Capacitor, fixed, Mylar, 0.123 μf ±1%, 400V	Efcon	MHY	S95-050	2					
	C523 C566		Same as C522 except 0.039 μf	Efcon	MHY	S95-051	2					
	C524 C567		Same as C522 except 0.0123 μf	Efcon	MHY	S95-052	2					
	C525 C568		Same as C506 except 3900 μμf	Elmenco	CM-30A	S95-053	2					
	C526 C569		Same as C507 except 1230 μμf	Elmenco	CM-19A	S95-054	2					
	C527 C570		Same as C514 except 390 μμf	Elmenco	CM-15A	S95-055	2					
	C528 C571		Same as C514 except 123 μμf	Elmenco	CM-15A	S95-056	2					
	C529		Same as C522 except 0.04 μf	Efcon	MHY	S95-057	1					
	C530		Same as C522 except 0.0127 μf	Efcon	MHY	S95-068	1					
	C531		Same as C506 except 4000 μμf	Elmenco	CM-30A	S95-069	1					
	C532		Same as C507 except 1270 μμf	Elmenco	CM-19A	S95-070	1					
	C533		Same as C514 except 400 μμf	Elmenco	CM-15A	S95-071	1					
	C534		Same as C514 except 127 μμf	Elmenco	CM-15A	S95-072	1					
	C535		Same as C514 except 40 μμf	Elmenco	CM-15A	S95-073	1					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	D401 D404		Diode, Zener, 300V ±5%, matched pair per EMR Dwg. A-01966	Hoffman	1N215	S95-074	1 pr.			PP-LL-QC		
	D402		Diode, Zener, 90V ±5%	Hoffman	G-3013(9)	S95-075	1					
	D403		Diode, rectifier, selenium, 940 PIV	IRC	9GA20-3C	S95-076	1					
	F1		Fuse, 2.0 a	Littelfuse	313002	S95-077	1					
	F2		Fuse, 0.5 a	Littelfuse	313.500	S95F-078	1					Used only on 95F.
	I1		Bulb, pilot	GE	328	S95-079	1	2	2			
	J1		Connector, female, 32-pin	Cannon	DPD-D32C2-33S-1L	S95-080	1					
	L1		Reactor, filter, 12 h	Colin Campbell	L1855	S95-081	1			PP-LL		
	L401		Choke, rf, 0.1 mh	Miller	4632	S95-082	1					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	M401		Meter, 100-0-100 μa	Marion	HS-2 Special	S95-083	1			PP-LL		
	P1		Connector, male, 32-pin	Cannon	DPD-D32C2-34P-1L	S95-084	1					
	R1		Resistor, fixed, wire-wound, 100Ω±10%, 25W	Dale	B-25	S95-085	1					
	R2		Resistor, fixed, deposited carbon, 330K ±1%, 1/2W	Electra	DC1/2C	S95-086	1					
	R3		Resistor, fixed, wire-wound, 6.485K ±1%, 5W	Dale	RS-5	S95-087	1					
	R4		Resistor, fixed, wire-wound, 25K ±1%, 10W	Dale	RS-10	S95-088	1					
	R4A R416		Resistor, fixed, composition, 820K ±10%, 1/2W	Allen-Bradley	EB	S95-089	2					
	R5 R17		Same as R4A except 5.6K	Allen-Bradley	EB	S95-090	2					
	R6		Same as R4A except 270K	Allen-Bradley	EB	S95-091	1					
	R7		Same as R2 except 39K	Electra	DC1/2C	S95-092	1					
	R8		Resistor, fixed, molded deposited carbon, 150K ±1%, 1/2W	IRC	MDC	S95-093	1					
	R9		Same as R8 except 82K	IRC	MDC	S95-094	1					
	R10 R407 R411 R425		Same as R4A except 1M	Allen-Bradley	EB	S95-095	4	1	1			

Electro-Mechanical Research, inc.
P. O. BOX 3041
Phone 958-7731
SARASOTA, FLORIDA
TWX SARASOTA 6006

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	R11 R438		Same as R4A except 47K	Allen-Bradley	EB	S95-096	2					
	R12 R439		Same as R4A except 10K	Allen-Bradley	EB	S95-097	2					
	R13 R20		Same as R3 except 8K	Dale	RS-5	S95-098	2					
	R14		Same as R3 except 5.895K	Dale	RS-5	S95-099	1					
	R15		Same as R2 except 820K	Electra	DC1/2C	S95-100	1					
	R16		Same as R4A except 470K	Allen-Bradley	EB	S95-101	1					
	R18		Same as R4A except 220K	Allen-Bradley	EB	S95-102	1					
	R19		Same as R3 except 10K	Dale	RS-5	S95-103	1					
	R21		Resistor, fixed, deposited carbon, 38.1K ± 1%, 1W	Electra	DC1	S95-104	1					
	R22		Resistor, fixed, deposited carbon, 4.1K ± 5%, 1/2W	Electra	DC1/2C	S95-105	1					
	R23		Same as R2 except 47K	Electra	DC1/2C	S95-106	1					
	R24		Same as R21 except 26.5K	Electra	DC1	S95-107	1					
	R25		Same as R2 except 120K	Electra	DC1/2C	S95-108	1					
	R26		Same as R2 except 100K	Electra	DC1/2C	S95-109	1					
	R27 R28 R404 R434 R441		Same as R4A except 68Ω	Allen-Bradley	EB	S95-110	5	1	1			
	R29		Same as R4A except 18K	Allen-Bradley	EB	S95-111	1					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	R30		Resistor, fixed, wire-wound, 5.5K ±3%, 5W	Sage	SR5W	S95-112	1					
	R31		Resistor, fixed, wire-wound, 1.8K ±10%, 10W	Milwaukee	Oval	S95-113	1					
	R401 R413 R415		Resistor, fixed, composition, 22K ±10%, 1W	Allen-Bradley	GB	S95-114	3	0	1			
	R402 R418		Resistor, fixed, deposited carbon, 3.3K ±1%, 1/2W	Electra	DC1/2A	S95-115	2					
	R403		Same as R401 except 47K	Allen-Bradley	GB	S95-116	1					
	R405		Same as R4A except 220K	Allen-Bradley	EB	S95-117	1					
	R406 R424		Same as R4A except 680Ω	Allen-Bradley	EB	S95-118	2					
	R408		Same as R402 except 33K	Electra	DC1/2A	S95-119	1					
	R409		Same as R4A except 3.3M	Allen-Bradley	EB	S95-120	1					
	R410		Same as R4A except 330Ω	Allen-Bradley	EB	S95-121	1					
	R412		Same as R4A except 2.2M	Allen-Bradley	EB	S95-122	1					
	R414 R435		Same as R401 except 18K	Allen-Bradley	GB	S95-123	2					
	R417		Same as R4A except 1.2M	Allen-Bradley	EB	S95-124	1					
	R419		Resistor, variable, wire-wound, 5K ±5%, 1.5W	Clarostat	49M-9	S95-125	1					
	R421		Same as R4A except 33Ω	Allen-Bradley	EB	S95-126	1					
	R422 R429		Same as R402 except 1.8K	Electra	DC1/2A	S95-127	2					
	R423		Same as R4A except 220K	Allen-Bradley	EB	S95-128	1					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	R426		Same as R4A except 1.8M	Allen-Bradley	EB	S95-129	1					
	R427 R432		Same as R4A except 390K	Allen-Bradley	EB	S95-130	2					
	R428 R442		Same as R4A except 100K	Allen-Bradley	EB	S95-131	2					
	R430		Resistor, fixed, composition, 4.7K ±10%, 2W	Allen-Bradley	HB	S95-132	1					
	R431		Same as R402 except 330Ω	Electra	DC1/2A	S95-133	1					
	R433A		Same as R430 except 120K	Allen-Bradley	HB	S95-134	1					
	R433B		Same as R430 except 100K	Allen-Bradley	HB	S95-135	1					
	R436		Same as R4A except 180K	Allen-Bradley	EB	S95-136	1					
	R437		Same as R4A except 82K	Allen-Bradley	EB	S95-137	1					
	R440		Same as R4A except 330K	Allen-Bradley	EB	S95-138	1					
	R447		Part of SW3, which see.									
	R450		Same as R402 except 1K	Electra	DC1/2A	S95-139	1					
	R451		Same as R402 except 2.2K	Electra	DC1/2A	S95-140	1					
	R452		Same as R402 except 6.8K	Electra	DC1/2A	S95-141	1					
	R453		Same as R402 except 12K	Electra	DC1/2A	S95-142	1					
	R454		Same as R402 except 27K	Electra	DC1/2A	S95-143	1					
	R501 R503 R505 R507		Resistor, variable, 100K ±5% (one assembly of four)	Gen. Radio	974RG 4S1	S95-144	1 assy.					

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER		EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO.		PP-PART PECULIAR LL-LONG LD		REMARKS
				NAME	PART NO.			BASE SPARES	FIELD SPARES			
	R502 R504 R506 R508 R552 R554 R556 R558		Same as R402 except 40K	Electra	DC1/2A	S95-145	8	2	1			
	R509 R510		Same as R402 except 4K	Electra	DC1/2A	S95-146	2					
	R551 R553 R555 R557		Resistor, variable, 100K ± 5% (one assembly of four)	Gen. Radio	974RG 4S2	S95-147	1 assy.					
	S501		Switch, rotary, 8-section, 7-position	Centralab	Per EMR Dwg. B-02346	S95-148	1			PP-LL		
	S502		Switch, rotary, 1-section, 2-position	Centralab	Per EMR Dwg. B-02343	S95-149	1			PP-LL		
	SW1		Switch, toggle	Arrow-Hart & Hegeman	81024-F	S95-150	1					
	SW3		Switch, rotary, 3-section, 5-position, with concentric 5K potentiometer (R447)	Centralab	Per EMR Dwg. B-02342	S95-151	1			PP-LL		
	SW401		Switch, pushbutton	Hetherington	C-100P-3R	S95-152	1					
	SW402		Switch, pushbutton	Microswitch	2AC21 Modified per EMR Dwg. A-00186	S95-153	1			PP-LL		

Electro-Mechanical Research, inc.
P. O. BOX 3041 SARASOTA, FLORIDA
Phone 958-7731 TWX SARASOTA 6006

EMR MODEL No. 95D&F

DATE 6/20/61
REVISION

Provisioning Spare Parts List

ITEM NO.	CIRCUIT SYMBOL NO.	STOCK NUMBER	DESCRIPTION	MANUFACTURER NAME	MANUFACTURER PART NO.	EMR PART NO.	QTY. IN EQT.	RECOM'D 6 MO. BASE SPARES	RECOM'D 6 MO. FIELD SPARES	PP-PART PECULIAR LL-LONG LD.		REMARKS
	T1		Transformer, power, with 4-μf capacitor (C15)	Colin Campbell	L2002	S95D-154	1			PP-LL		Used only on 95D.
	T1		Transformer, power	Colin Campbell	L1926	S95F-154	1			PP-LL		Used only on 95F.
	V1 V2		Tube, vacuum	Sylvania	5V4GA	S95-155	2	1	2			
	V3		Tube, vacuum	RCA	6080	S95-156	1	1	1			
	V4 V6		Tube, vacuum	Tung-Sol	6AW8A	S95-157	2	1	2	PP-LL		Aged at EMR.
	V5		Tube, gas	Raytheon	5651WA	S95-158	1	1	1			
	V401 V403		Tube, vacuum	GE	12AY7	S95-159	2	1	2			
	V402		Tube, vacuum	RCA	6U8	S95-160	1	1	1			
	V404		Tube, vacuum	RCA	6AU6	S95-161	1	1	1			
	V405		Tube, vacuum	RCA	6197	S95-162	1	1	1			
	V406		Tube, vacuum	GE	6L6GC	S95-163	1	1	1			
	---		Fuseholder	Littelfuse	342012	S95-164	1					
	---		Jack, pin, red	E. F. Johnson	105-602-1	S95-165	1					
	---		Jack, pin, blue	E. F. Johnson	105-610-1	S95-166	1					